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Denver,
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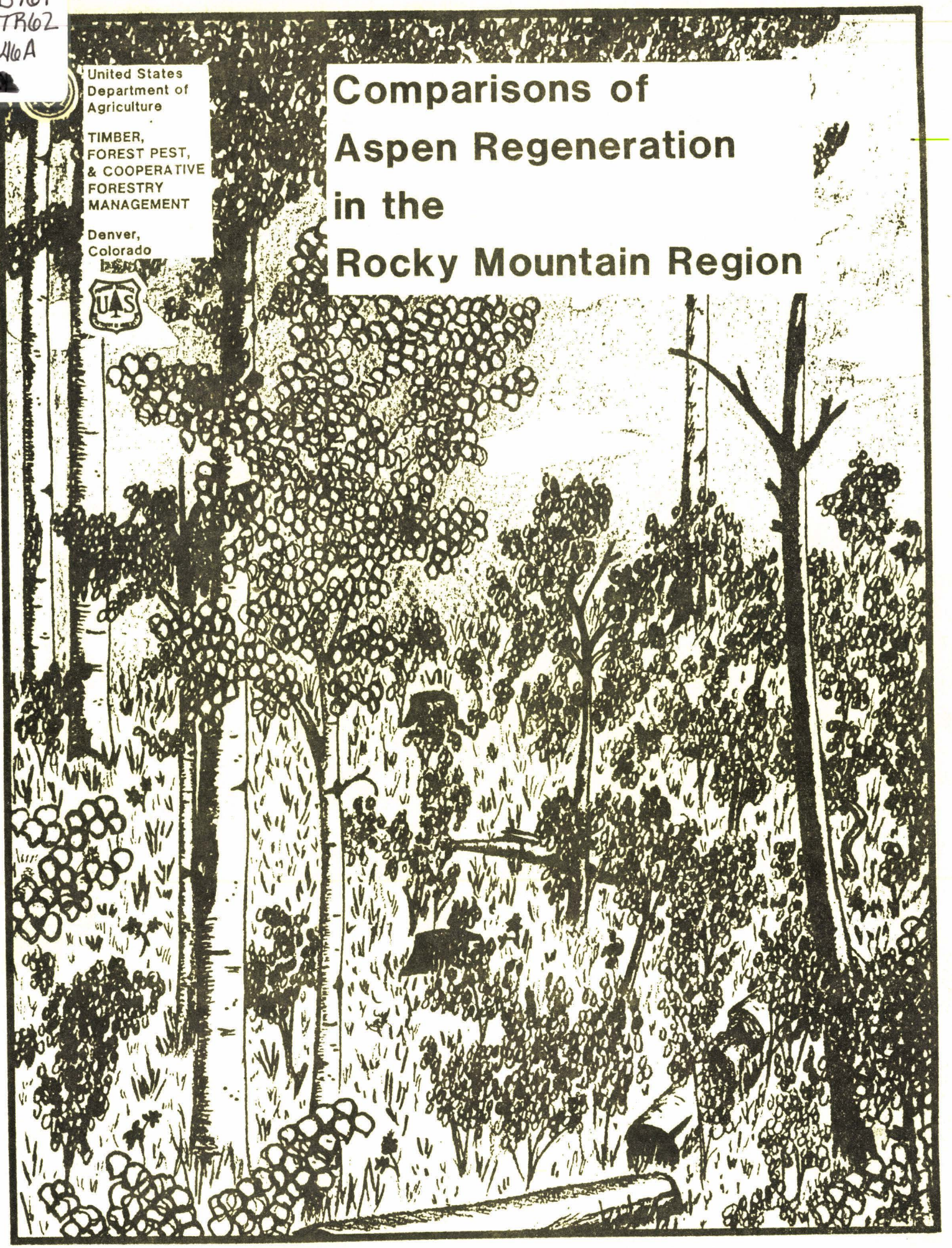
Comparisons of Aspen Regeneration in the Rocky Mountain Region



Comparisons Between Aspen Harvest Units With and Without Adequate Resprouting In the Rocky Mountain Region

Technical Report R2-46 A

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INTRODUCTION

Increased opportunities for aspen utilization in the Rocky Mountain Region have stimulated more aspen harvesting and management. The preferred regeneration method is clearcutting followed by root sprouting. The small percentage of aspen clearcuts that fail to regenerate or sprout and then die back are becoming an increasing concern. Land managers need the ability to predict whether a given aspen stand will successfully regenerate after harvest. To gather basic information and make general correlations, Forest Pest Management conducted a survey in the summers of 1988 and 1989. For the survey, foresters on participating Ranger Districts in Colorado, Wyoming, and South Dakota provided locations and other information on pairs of aspen clearcuts with different levels of regeneration success. The number of aspen sprouts that is adequate to restock a stand at any given time after harvest is a matter of some contention. In this evaluation, a "poor" stand had fewer and smaller sprouts than the "good" stand in the pair.

OBJECTIVE

The main objective of this evaluation was to ascertain if there were any site or stand parameters that could be correlated with poor regeneration, in order to predict regeneration failure before harvest.

METHODS

Each of 12 poorly regenerating aspen clearcuts was paired with one regenerating well, of similar age, aspect, slope and elevation where possible. Other site information collected, if available, included habitat type, size of harvest unit, season of harvest, age at harvest, and general site observations (Table 1). Whether a stand was regenerating poorly or well was determined visually.

The 12 pairs of aspen clearcuts included one on Elk Mountain Ranger District (RD), Black Hills National Forest (NF), South Dakota; one on Collbran RD, Grand Mesa-Uncompahgre-Gunnison NF, Colorado; two on Hayden RD, Medicine Bow NF, Wyoming; one on South Park RD, Pike-San Isabel NF, Colorado; three on Yampa RD, Routt NF, Colorado; one near Carter Mountain on Colorado State Forest land north of Kremmling, Colorado; one on Dolores RD, San Juan NF, Colorado; and two on Mancos RD, San Juan NF.

For each stand, a minimum of 10 plots were spaced regularly along 2 to 4 line transects. For each plot (2 x 2 m), live and dead aspen sprouts were tallied. Percentage of ground cover by the 3 to 5 most predominant types of ground cover was estimated. A listing of the types of ground cover is provided in Appendix A.

In each plot, 3 dominant aspen sprouts were measured and examined for various conditions listed in Table 1. Roots were examined if the crown was less than 40% alive; otherwise the root was assumed to be healthy.

Statistical analyses of the entire data set included analysis of variance by stand condition (poor or good) for each measured variable, and Chi-Squared analysis of stand condition by occurrence of a coded variable (see Table 1). A description of each stand is included in Appendix B.

Table 1. Variables measured or coded for aspen stands, plots, and dominant sprouts.

Stand Variables

Percent Slope Elevation

Aspect: coded for North, Northwest, West, Southwest, South, Southeast, East, Northeast

Topography: coded for Ridge, Upper-, Mid-, Lower-Slope, Bench or Flat, Stream Bottom

Configuration: coded for Convex, Straight, Concave, Undulating

Plot Variables

Number of Live Aspen Sprouts Number of Dead Aspen Sprouts

Understory Cover: coded for Plants, Bare Ground or Duff, Logs or Slash

Dominant Sprout Variables

Diameter at ground Age at ground Height Percent of Crown Alive

Stem Form: coded for Straight, Swept or Crooked, Forked, Multiple Stem, Leaning

Stem Disease: coded for No Disease, Cytospora Canker, Tip Dieback

Stem Insects: coded for No Insects, Borers, Oviposition Wound with Cytospora, Other

Stem Damage: coded for No Damage, Browsing/Barking, Trampling, Snow Damage, Mechanical Wounds, Stem Dieback, Other

Foliage Disease: coded for No Disease, Shepherd's Crook, Marssonina, Ink Spot, Chlorosis, Other

Root Cambium: coded for Healthy, Discolored, Dead

Root Xylem: coded for Healthy, Discolored

Root Rot: coded for No Root Rot, Armillaria root disease, Other.

RESULTS

Table 2 provides a summary of stand and dominant sprout data for the 12 pairs of stands.

Stands

The 12 pairs of stands were compared by condition (poor or good). When the slopes differed between the pairs of stands, the good stands had significantly greater slopes. When topographic positions differed between the pairs of stands, good stands were positioned significantly more often on mid to upper slopes, while poor stands tended to be on benches, stream bottoms, and lower slopes. By observation, dry sites and wet sites had problems regenerating. Herbivore pressure was a strong negative influence for aspen regeneration in general.

Plots

Although analyses of plot data disclosed some significant differences, much of the plot information may not have predictive value because most of the sprouts and some of the understory plants developed because the original stand was harvested. There were significantly more live sprouts in the good stands. Poor stands had significantly more yarrow, more dandelion, more strawberry, more corn husk lily (a wet-site indicator), more grasses in general but less brome and bluegrass. Good stands had significantly more occurrence of logs and slash, more osmorhiza, more snowberry, and more meadow rue.

Dominant Sprouts

Analyses of data from the dominant sprouts provide an assessment of the conditions in the stands. Variables which were significantly different between poor and good stands are listed in Table 3. Some interesting differences include age: sprouts were older in good stands--in some cases the good stands sprouted well and more sprouts survived compared to poor stands where earlier sprouts had not survived and the few sprouts present were young. In some cases more advanced regeneration survived the cutting on good stands or the good stand was cut longer ago. Herbivore use: many more poor stands suffered browsing damage. Root condition: there were more dead and discolored roots in the poor stands, but these were mostly attributable to factors other than root disease.

Some conditions not listed in Table 3 occurred rarely, but according to statistical tests, differed significantly between poor and good stands. These include: leaf miners on 4% of sprouts in poor stands, but only 1% in good stands; some unidentified root rot on 4% of sprouts in poor stands, but only 0.3% in good stands.

Table 2. Characteristics for aspen stands, average data for the plots (2 x 2 m) in each stand, and average data for the dominant sprouts in each plot. To convert numbers of live or dead sprouts per plot into numbers per acre, multiply by 1000.

Acres Cut	Year Cut	Elev. (ft)	Slope/Aspect/ Configuration	# Plots	Live Sprouts	Dead Sprouts	# Dom. Sprouts	Diam. (cm)	Ht. (m)	% Live	Age (yr)
Black Hills National Forest											
Red Bird Draw, surveyed 7/88.											
POOR											
3.3	1985	6200	10%/NE/Straight	10	8.0	0.5	26	1.2	0.8	92	3.1
GOOD											
same	same	same	20-35%/NE/Undulating	10	13.0	0	30	0.8	0.8	95	1.9
Grand Mesa, Uncompahgre, Gunnison National Forest											
Cow Camp, surveyed 9/88.											
POOR											
10	1981	9800	0%/--/Undulating	10	1.0	0.3	11	1.6	0.7	50	5.5
GOOD											
same	same	same	15%/SW/Straight	11	2.7	0.7	25	4.2	2.1	69	10.0
Medicine Bow National Forest											
Green Ridge, surveyed 6/89											
POOR											
8	7/79	8120	4%/NE/Straight	10	3.8	6.3	28	2.4	1.5	40	4.5
GOOD											
same	same	same	same	10	4.3	2.2	27	4.8	4.4	80	8.2
Sandstone, surveyed 7/88 and 6/89											
POOR											
5	1978	8340	3%/N/Straight	12	2.0	1.7	28	1.9	1.2	47	5.0
GOOD											
41	1983	8140	4%/W/Undulating	12	10.1	2.2	33	2.9	2.5	97	5.3
Pike and San Isabel National Forest											
Jefferson, surveyed 8/88											
POOR											
5	1983	10400	4%/E/Convex	10	3.2	1.1	18	2.0	1.1	54	3.6
GOOD											
same	same	same	3%/SE/Straight	10	16.2	2.2	29	2.3	1.6	93	4.4
Routt National Forest											
Blackhorse, surveyed 6/88											
POOR											
15	11/84	9200	5-30%/SE/Concave	20	3.4	0.5	19	0.6	0.5	78	1.8
GOOD											
4	1985	9000	12%/NE/Straight	11	6.3	6.0	33	1.4	0.9	56	2.8

Table 2 continued

Acres Cut	Year Cut	Elev. (ft)	Slope/Aspect/ Configuration	# Plots	Live Sprouts	Dead Sprouts	# Dom. Sprouts	Diam. (cm)	Ht. (m)	% Live	Age (yr)
Routt National Forest continued											
Chapman, surveyed 6/88											
POOR											
5	83,84	8880	5%/E/Concave	10	0	0	0	--	--	--	--
GOOD											
5?	1977?	8800	27%/SE/Convex	10	3.5	0.2	20	4.8	4.6	93	8.4
Porcupine, surveyed 6/88 and 6/89											
POOR											
6	83,84	9080	5-25%/S/Undulating	10	1.3	0.6	8	1.0	0.5	55	2.0
GOOD											
5	8/86	9460	15%/SW/Undulating	12	21.8	0.5	36	0.9	0.9	97	2.4
Colorado State Land											
Carter Mountain, surveyed 6/88											
POOR											
63	1/83	9240	12%/SE/Straight	11	4.1	5.5	26	1.4	0.9	33	1.6
GOOD											
same	same	same	25%/SE/Undulating	12	11.3	2.8	34	1.8	1.3	86	2.5
San Juan National Forest											
Aspen Guard Station, surveyed 7/88											
POOR											
4?	1985	9800	10%/W/Undulating	12	0.3	0	3	1.5	1.3	98	4.0
GOOD											
35?	1985?	9440	8%/NW/Straight	10	15.7	0	27	2.4	2.0	97	2.4
Burnt Ridge, surveyed 7/88											
POOR											
7	1983?	10060	13%/W/Concave	10	1.3	0.2	12	1.4	0.9	82	3.4
GOOD											
same	same	same	18%/W/Concave	10	9.5	1.7	30	1.9	1.4	91	3.3
Stoner Mesa, surveyed 7/88											
POOR											
15	1976	9320	18%/NW/Straight	12	0.5	1.3	18	3.0	2.4	30	5.2
GOOD											
same	same	same	same	10	1.9	1.3	20	4.8	4.3	77	8.2

Table 3. Average values or occurrences (%) of variables for dominant sprouts with significant differences ($P<0.05$) between 12 poor and 12 good stands.

Variable	Average in Poor Stands	Average in Good Stands
Diameter (cm)	1.7	2.7
Age (years)	3.9	5.2
Height (m)	1.0	2.0
Percent of Crown Alive	60	82
Straight Stem	41%	54%
Swept or Crooked Stem	41%	31%
No Stem Disease	79%	87%
Cytospora Canker	10%	2%
No Stem Damage	23%	53%
Browsing	42%	15%
Snow Damage	11%	5%
Mechanical Wounds	35%	25%
Healthy Root Cambium	77%	96%
Dead Root	21%	3%
Healthy Root Xylem	80%	95%

DISCUSSION

In surveying a variety of aspen stands throughout the Rocky Mountain Region, we are convinced that the factors associated with problems in aspen regeneration are complex, and not attributable to single causes. Different sets of problems occur in different areas, but some consistent factors emerge. Although aspen has broad ecological amplitude, survival and growth depend on a balance of appropriate environment, vigor of the aspen root system and sprouts, and destructive forces including disease and herbivores.

Herbivore pressure can shift the balance toward regeneration failure; for example, only 15% of dominant sprouts in good stands were browsed while 42% were browsed in poor stands. Trampling and feeding destroy shoots, draining carbohydrate reserves. Surface compaction changes water relations and contributes to root mortality. In some stands, for example, Green Ridge on Medicine Bow NF and Aspen Guard Station on San Juan NF, logs and slash apparently obstructed movement of herbivores and protected the aspen sprouts (Figures 1 and 2). A similar situation was observed on the PaintRock RD, Bighorn NF. However, research has shown that heavy slash can inhibit sprouting (Shepperd 1987). Of course, exclosures provide effective but expensive protection. Optimum movement of cattle throughout an allotment would require more effort and probably more fencing.

Water relations have important implications for aspen survival, better stands tended to be on steeper slopes and tended to be positioned on mid to upper slopes. On wet sites, harvest of trees probably raised the water table and drowned root systems. On a hot dry site, harvest of trees probably exposed the soil and root system to higher temperatures, greater moisture loss, and earlier snow melt. Earlier leafing out and early herbivore use followed by dessication probably contibuted to decreased vigor of the root system and sprouts (Figure 3).

Weather patterns and events can affect aspen survival. In some areas, snow damage was more intense on smaller harvest units (5 ac) than on larger units (40 ac), because the wind tended to scour the larger opening (Sandstone, Medicine Bow NF). Occasional drought (or other weather events) can give fungal diseases an advantage, especially if the aspen root system is established in soil that is usually quite moist (Cow Camp, Grand Mesa-Uncompahgre-Gunnison NF, and Stoner Mesa, San Juan NF).

In summary, the results of the survey provide the following general indications. Aspen stands in areas where cattle congregate, stands on dry ecotonal sites, on wet sites, on benches or in stream bottoms or with poor drainage, and small clearcuts in areas of heavy snow, will probably experience regeneration problems.

Cooperative research with Colorado State University, Soil Conservation Service, Rocky Mountain Forest and Range Experiment Station, and the Rocky Mountain Region (Regional Office, Grand Mesa-Uncompahgre-Gunnison National Forest; and San Juan National Forest), in the near future will include comparisons of soil series, water relations, fungal pathogens, herbivore use, and other factors. We are hopeful that additional factors useful for predicting the success of aspen regeneration can be identified.

Figure 1. Protection of aspen sprouts by logs and slash, Green Ridge, Medicine Bow NF.

A. Poor aspen regeneration in foreground, in portion of harvest unit between salt lick and piles of slash.

B. Poor survival of aspen regeneration where arrangement of slash allows easy access.

C. Slash piled along the center of harvest unit, with good aspen regeneration in background.

D. Aspen sprouts regenerating well where slash obstructs access.

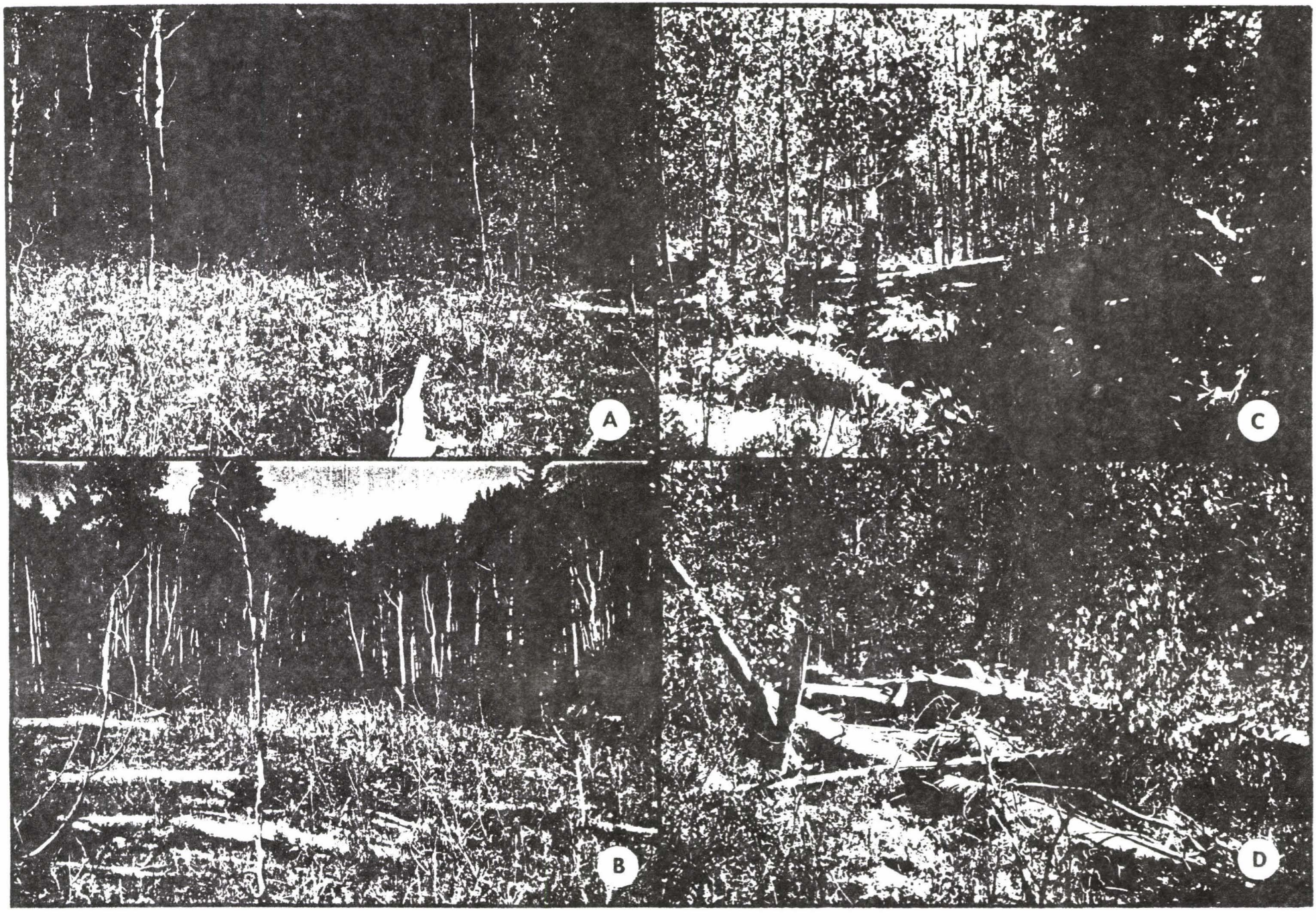
A
B
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Figure 2. Aspen Guard Station, San Juan NF, in spring before leaves have expanded: (A) Good stand, (B) Poor stand. Besides possible clonal and soil differences, windrowed slash and a partial buck and pole fence protected the good stand, while the poor stand is near a cattle guard where cattle apparently congregate.

A
B

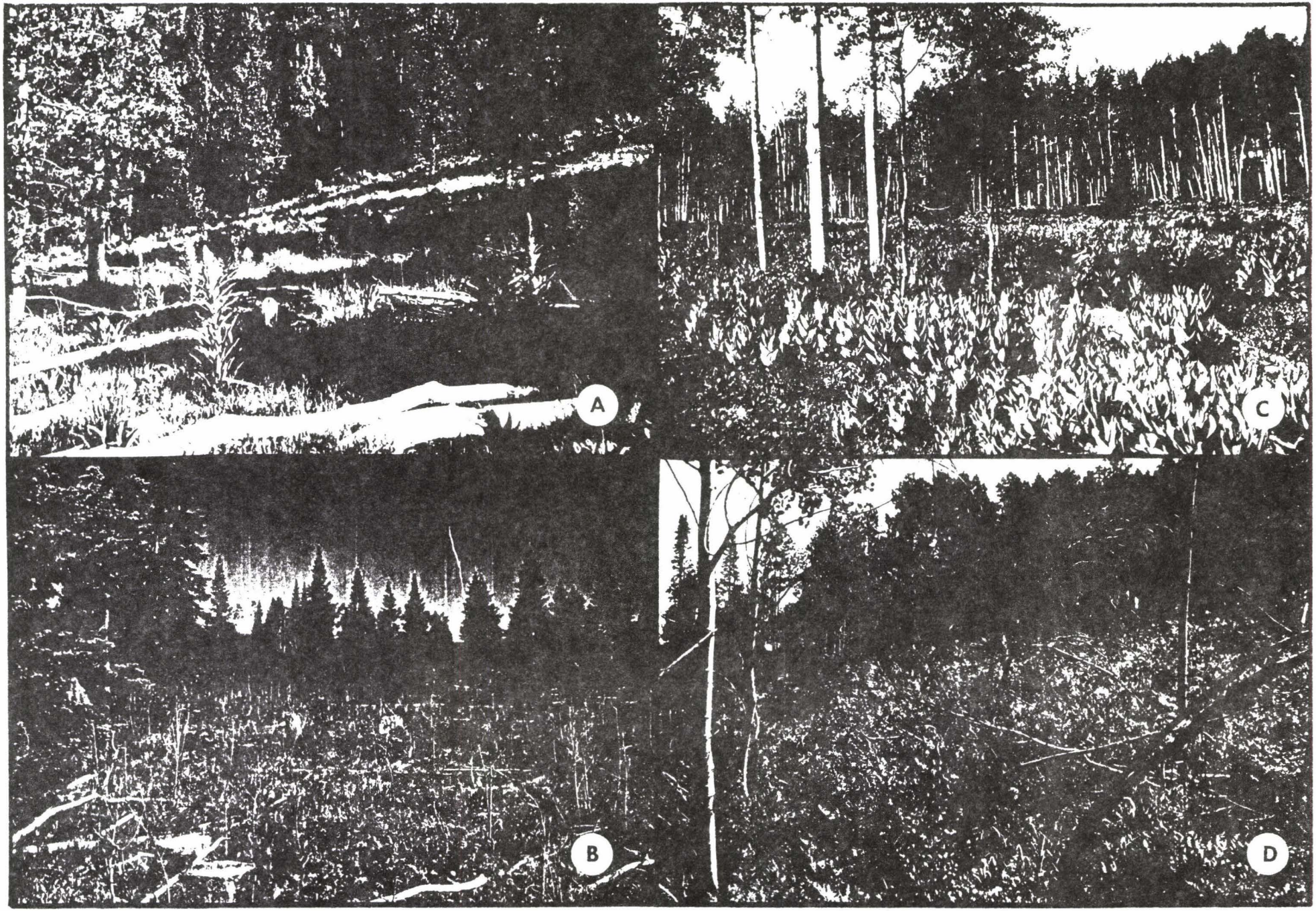
Figure 3. Different factors affect aspen regeneration:

A. Porcupine Poor, Routt NF. Very little aspen sprout survival on this south-facing slope between sage meadow and lodgepole pine. Probable factors include dry site, with early snowmelt and edge effect attracting herbivores.

B. Carter Mountain Poor, Colorado State land. Poor aspen sprout survival toward bottom of slope, closer to salt lick and pond, and where soil is heavier.

C. Chapman Poor, Routt NF. This harvest unit in a stream bottom failed to regenerate. The dense stand of corn husk lily indicates a wet site.

D. Stoner Mesa Poor, San Juan NF. Skeletons of several-year old sprouts that died back probably due to a combination of soil factors, weather events, and opportunistic fungal pathogens.


A
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APPENDIX A

Ground Cover List

Achillea lanulosa, yarrow
Amelanchier, service berry
Antennaria rosea, pussy toes
Aquilegia caerulea, columbine
Arctostaphylos uva-ursi, kinnickinnick
Arnica cordifolia
Artemesia, forb sage
Artemesia, sagebrush
Aster, white

Bare ground, just aspen , or duff
Bromopsis, brome

Carex geyeri, elk sedge
Capsella bursa-pastoris, shepherd's purse
Chamerion
Chrysothamnus nauseous, rabbitbrush
Cirsium, thistle
Collomia linearis

Delphinium occidentale, tall larkspur
Dugaldia (Helenium) hoopesii, orange sneezeweed

Ellisia
Erigeron elatior, purple daisy
Erigeron, white daisy
Erigeron, yellow daisy

Fragaria virginiana, strawberry
Frasera speciosa, monument plant

Geranium
Grasses

Heterotheca villosa
Helianthus, sunflower
Heracleum sphondylium montanum, cow parsnip
Hydrophyllum capitatum

Iris missouriensis

Juniperus communis, common juniper

Appendix A, continued

Lathyrus leucanthus
Ligusticum porteri
Logs, slash, stumps, sticks
Lonicera
Lupinus

Mertensia
moss

Osmorhiza depauperata
Oxytropis

Perideridia gairdneri
Pinus contorta, lodgepole pine
Poa, Poa pratensis, Kentucky blue grass
Potentilla fruticosa, Pentaphylloides floribunda, shrub cinquefoil
Potentilla gracilis
Prunus virginiana melanocarpa, choke cherry
Pseudostellaria jamesiana, tuber starwort

Ranunculus, buttercup
Ribes, currant
Rosa, wild rose
Rudbeckia lacinata, tall cone flower

Salix, willow
Senecio integerrimus, groundsel
Senecio, mid-size yellow
Symphoriocarpus, snowberry

Taraxicum officinale, dandelion
Thalictrum, meadow rue
Thermopsis, gold banner

Valeriana edulis
Veratrum tenuipetalum, corn husk lily
Veronica biloba
Vicia, vetch

APPENDIX B

Description of Aspen Stands by National Forest

BLACK HILLS NATIONAL FOREST, ELK MOUNTAIN RANGER DISTRICT

Red Bird Draw (Map on page 18)

T.1S, R.1E, S.34, SE quarter; Photo #581-79 "22K"
Elevation 6200 ft; midslope topographic position; total of about 3 1/3 ac cut in 1985. Dry in 7/88, grasshoppers evident.

On US HWY 16 SE of Newcastle, Wyo, turn left (east) onto FS 117. Head north on FS 117 (Boles Canyon), past the junction of FS 284N (Dumbuk Ridge). Turn right (east) onto FS road to Red Bird Draw. Go 2.1 mi to junction of E. Heggie Rd, turn right (SE) and go 0.15 mi. Stands are up on little hill to west.

Poor Portion of Cut

The worse portion of the cut is farthest north, about 1.3 ac sloping 10% to NE. Predominant understory: grasses, forb sage, potentilla forb.

In 10 plots surveyed 7/88, 26 dominant sprouts were measured: 1-7 yrs old, ave. diam 1.2 cm, ave height 0.8 m, ave percent of crown alive 92%. Average number of live sprouts per plot 8.0, and dead 0.5. Grasshoppers and shepherd's crook common.

Good Portion of Cut

Better portion of cut is farther south, about 2 ac sloping from 20 to 35% to NE. Predominant understory: grasses, shrub cinquefoil, mint.

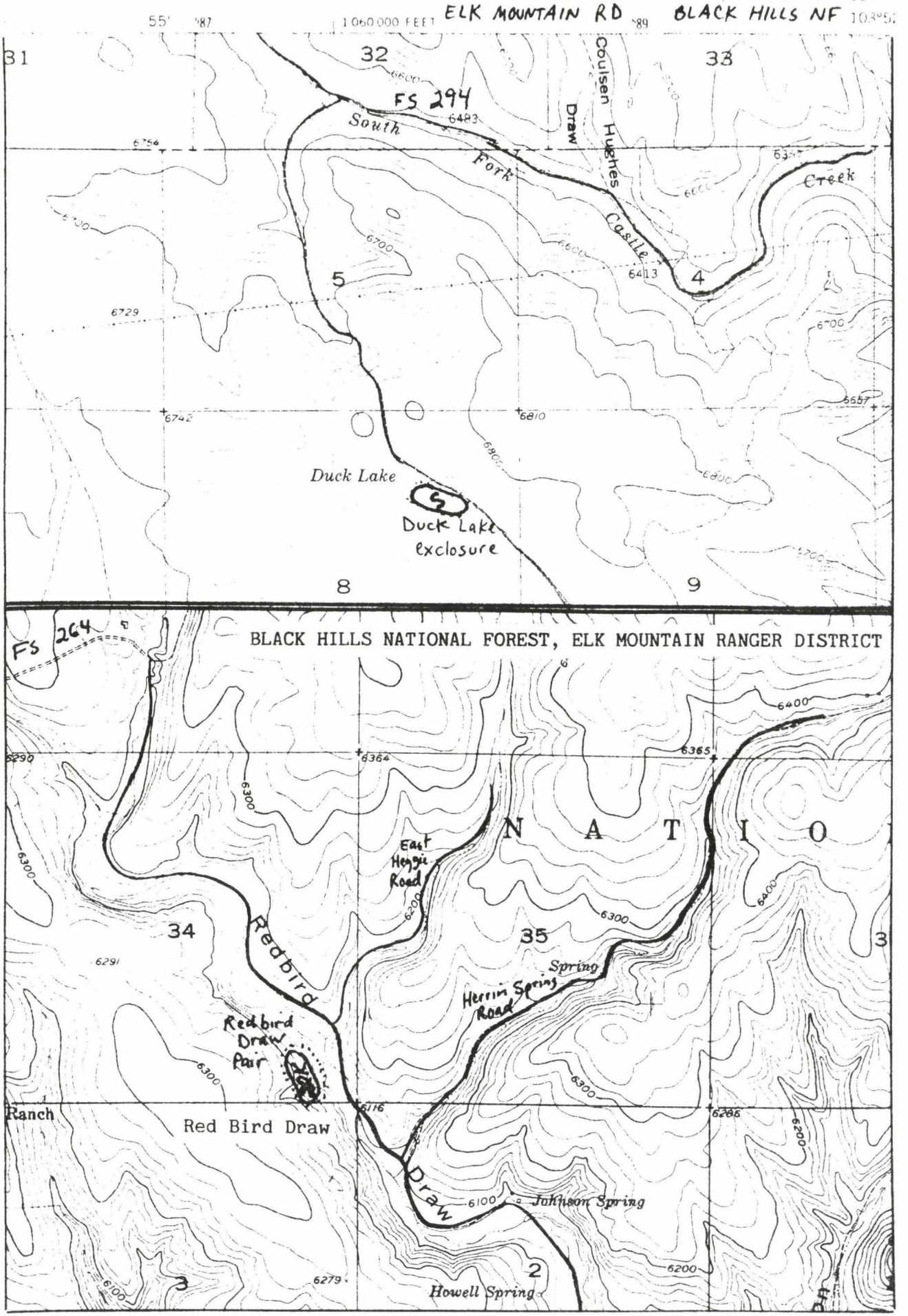
In 10 plots surveyed 7/88, 30 dominant sprouts were measured: 1-7 yrs old, ave. diam. 0.8 cm, ave. height 0.8 m, ave percent crown alive 95%. Average number of live sprouts per plot 13, and dead zero. Grasshoppers and shepherd's crook common.

Duck Lake (Map on page 18)

T.1S., R.1E., S.8, NE quarter; Photo #781-48 "S"; elevation 6700 ft, mostly flat.

On US HWY 16 SE of Newcastle, Wyo, turn east onto FS 117. Head north on FS 117 (Boles Canyon) to FS 294. Head east on FS 294, go 6.2 mi to trail road. Turn south 1.5 mi past Duck Pond. The aspen here was cut in 1985 and enclosed in 1987. This stand was not surveyed, but in 7/88 aspen sprouts were dense, with small leaves and shepherd's crook. Grasses, shrub cinquefoil, and wild iris were noted in the vicinity. Cattle congregate near the pond and deer use was also evident. The exclosure will probably help this aspen survive; sprouts were sparse outside of the fence.

PREACHER SPRING QUADRANGLE
SOUTH DAKOTA--PENNINGTON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



GRAND MESA, UNCOMPAHGRE, GUNNISON NATIONAL FOREST, COLLBRAN RANGER DISTRICT

Cow Camp (Map on page 20)

T.11 S., R.94 W., S.9; elevation 9800 ft, total 10 ac cut 1981 with aspen 1" in diameter and less were left. Spruce-fir habitat type, deep soil.

On FS 121 south from Collbran, Colo, about 3.5 mi from forest boundary, turn northeast on FS 279 for 0.3 mi. Cut stand is on both sides of the road; the portion on right side (southeast) of road was surveyed.

Poor Portion of Stand

Poor sprout survival on northeast portion of cut, on bench top. Predominant understory: grasses, Ligusticum, and tall delphinium. Corn husk lily and subalpine fir present. Many sprouts showed browsing, dieback, and/or snow damage. Cow trampling and bedding down evident.

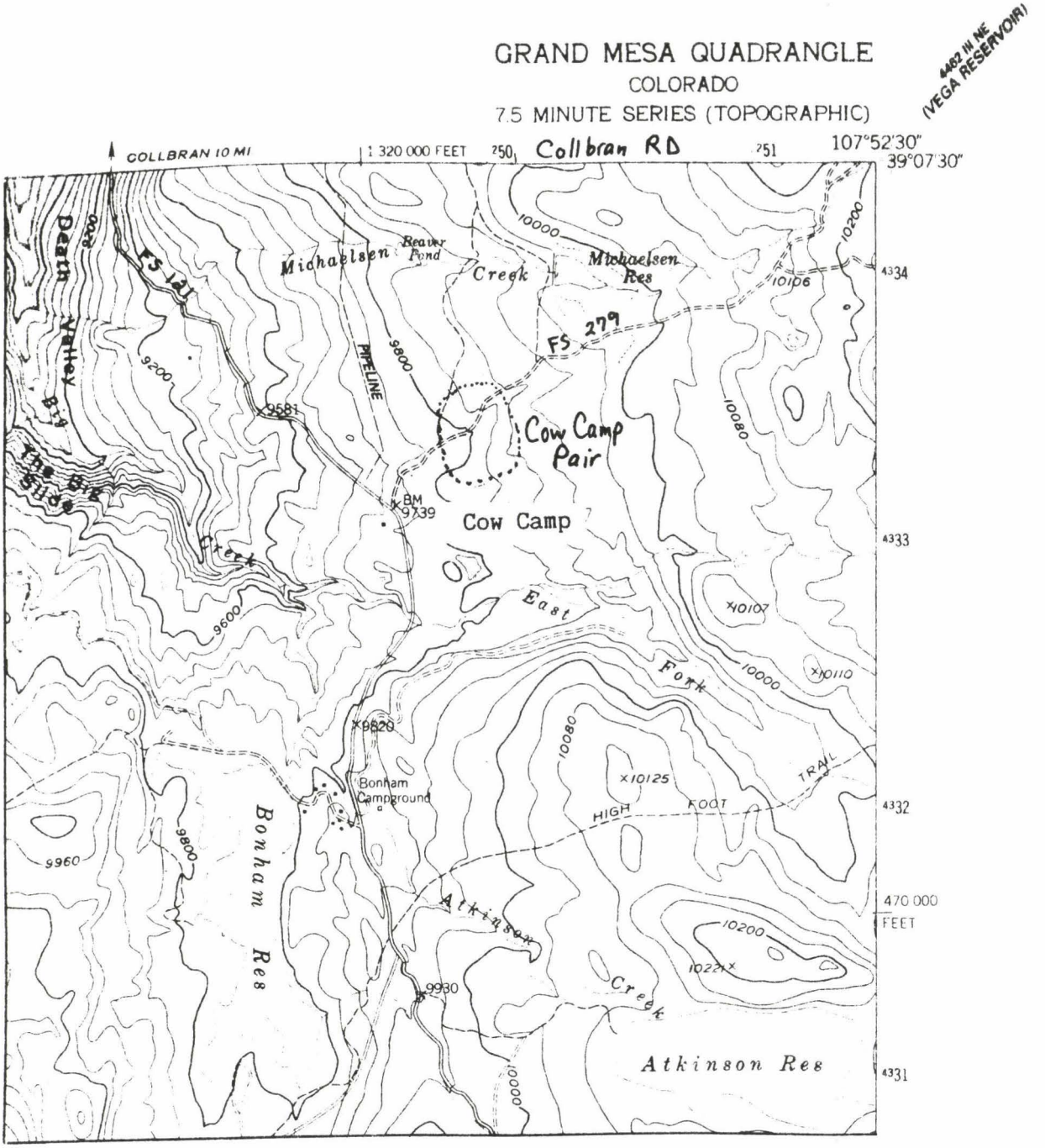
In 10 plots surveyed 9/88, 11 dominant sprouts were measured: 1-12 yrs old, ave. ht. 0.7 m, ave. diam. 1.6 cm, ave percent crown alive 50%. Average number of live sprouts per plot 1.0, and dead 0.3.

Good Portion of Stand

Good regeneration on southern part of cut, on slope 15% to southwest. Predominant understory: grasses, Ligusticum, and meadow rue. Snow damage and/or dieback evident on most sprouts. Cattle trails, trampling, and browsing evident. Corn husk lily present

In 11 plots surveyed 9/88, 25 dominant sprouts were measured: 2-16 yrs old, ave. height 2.1 m, ave. diam. 4.2 cm, ave. percent of crown alive 69%. Average number of live sprouts per plot 2.7, and dead 0.7. Most of dominant sprouts were alive before the stand was cut.

Water relations seem to be the major difference between the poor and good portions of this cut. Deeper roots on the slope fared better than roots close to the surface on the poorly drained flat area. Unusually droughty summers in 1987 and 1988 probably stressed the aspen more on the flat.



Grand Mesa National Forest
Collbran Ranger District

MEDICINE BOW NATIONAL FOREST, HAYDEN RANGER DISTRICT

Sandstone Pair (Map on page 22)

Poor Stand

T.13 N., R.87 W., S.8; stand 209504-70; elevation 8340 ft, 5 ac cut in 1978, sloping 3% to N; topographic position--bench.
Habitat type: Abla-Pien/Cage; no spruce seen; predominant understory: grasses, vetch, Ligusticum.

On Wyo HWY 70 (FS 11) west of Encampment, Wyo, to Sandstone Work Station. Keep heading west 2.6 mi to aspen cut north of road.

This stand was cut, piled, burned, and roller chopped. This much treatment is probably detrimental to the aspen root system. Armillaria root disease was found killing scattered seedling and sapling subalpine fir, but none of the aspen or lodgepole pine regeneration.

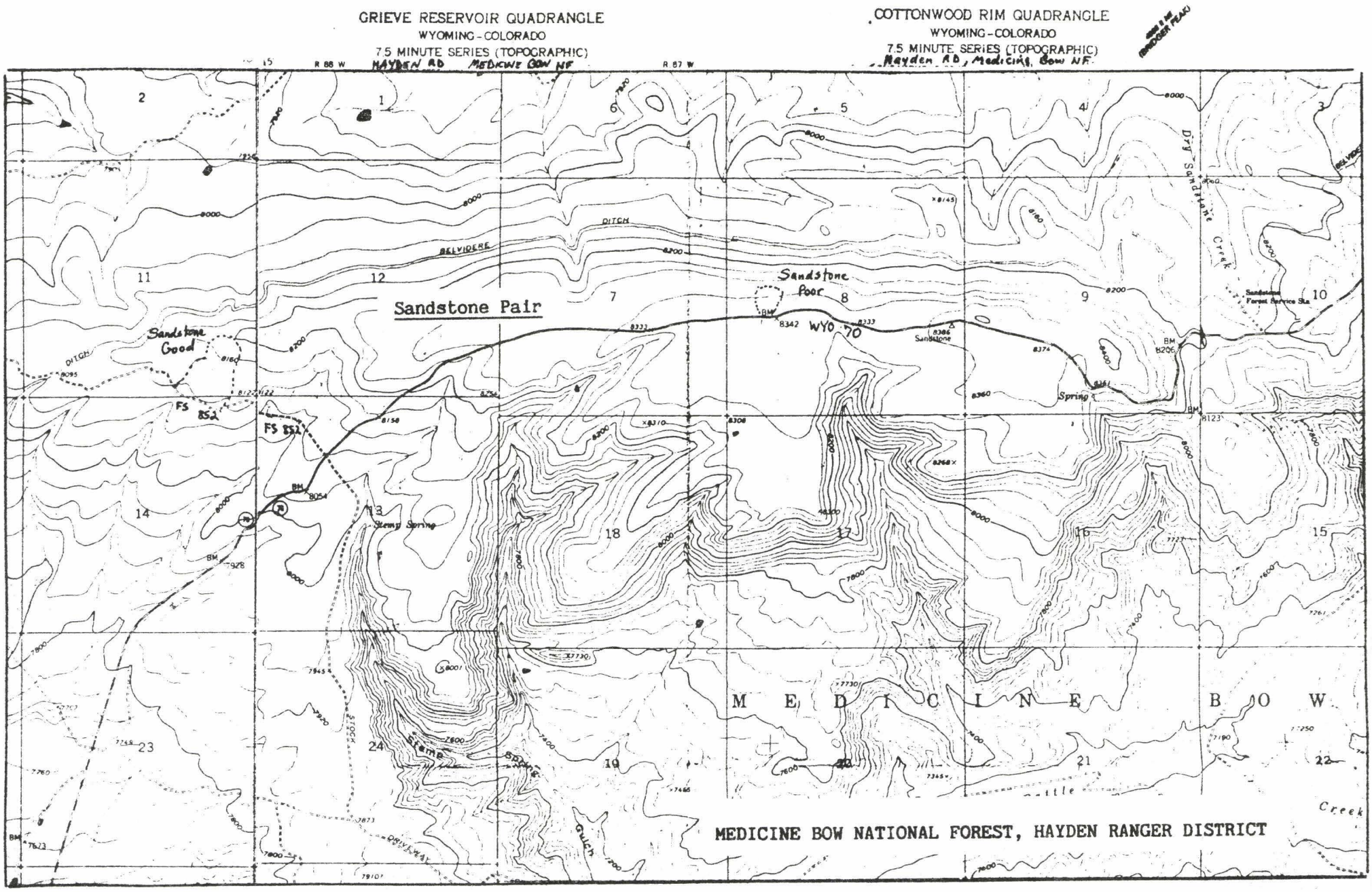
In 12 plots surveyed 7/88, 28 dominant sprouts were measured: 3-9 yers old, ave. diam. 1.9 cm, ave. height 1.2 m, ave. percent crown alive 47%. Average number of live sprouts per plot 2.0, and dead 1.7. Most sprouts crooked and bent from snow damage; no evidence of herbivore use.

Good Stand

T.13 N, R.88 W.,S.11; stand 210002-22 and 209508-22; elevation 8140, 41 ac cut July 1983, sloping 4% to W; topographic position--bench.
Habitat type: Abla-Pien/Cage; no spruce seen, some white fir; predominant understory: Poa, logs/slash, Ellisia.

On Wyo HWY 70 (FS 11) west of Encampment, Wyo, to Sandstone Work Station. Keep heading west 4.5 mi to junction of FS 852, west on FS 852 for 0.7 mi. Stand is large cut north of road, separated from stock driveway by a fence.

In 12 plots surveyed 6/89, 33 dominant sprouts were measured: 4-12 yrs old, ave. diam. 2.9 cm., ave height 2.5 m, ave. percent crown alive 97%. Average number of live sprouts per plot 10.1, and dead 2.2. This cut was large enough for wind to scour out snow, preventing snow damage. Little disease activity noted in this clone.


GRIEVE RESERVOIR QUADRANGLE
WYOMING - COLORADO
7.5 MINUTE SERIES (TOPOGRAPHIC)
HAYDEN RD MEDICINE BOW NF
COTTONWOOD RIM QUADRANGLE
WYOMING - COLORADO
7.5 MINUTE SERIES (TOPOGRAPHIC)
Hayden RD, Medicine Bow NF
R 88 W
R 87 W
Sandstone Pair
Sandstone Good
Sandstone Poor
WYO 70
FS 852
FS 852
Stemy Spring
Stemy
Spring
Gulch
DRIVEWAY
DITCH
BELVIDERE
Dry Sandstone Creek
Sandstone Forest Service Sta
Spring
Sandstone
MEDICINE BOW
MEDICINE BOW NATIONAL FOREST, HAYDEN RANGER DISTRICT

MEDICINE BOW NATIONAL FOREST, HAYDEN RANGER DISTRICT

Green Ridge (Map on page 24)

T.14 N., R.88 W., S.14; stand 209302-10; elevation 8120 ft, 8 ac cut July 1979, sloping 4% to NE; topographic position--flat. Habitat type: Abla-Pien/Cage; no spruce seen.

On Wyo HWY 70 west of Encampment, Wyo, turn NW on FS 801 (before Sandstone Work Station). Turn west on FS 876 for 1.1 mi to FS 876 1F. Turn on FS 876 1F for 0.1 mi to gate, continue 0.3 mi through first clearcut to tree-bordered road. Walk past salt lick east of road, through trees on cow trail about 100 m to east-southeast to cut.

Poor Portion of Cut

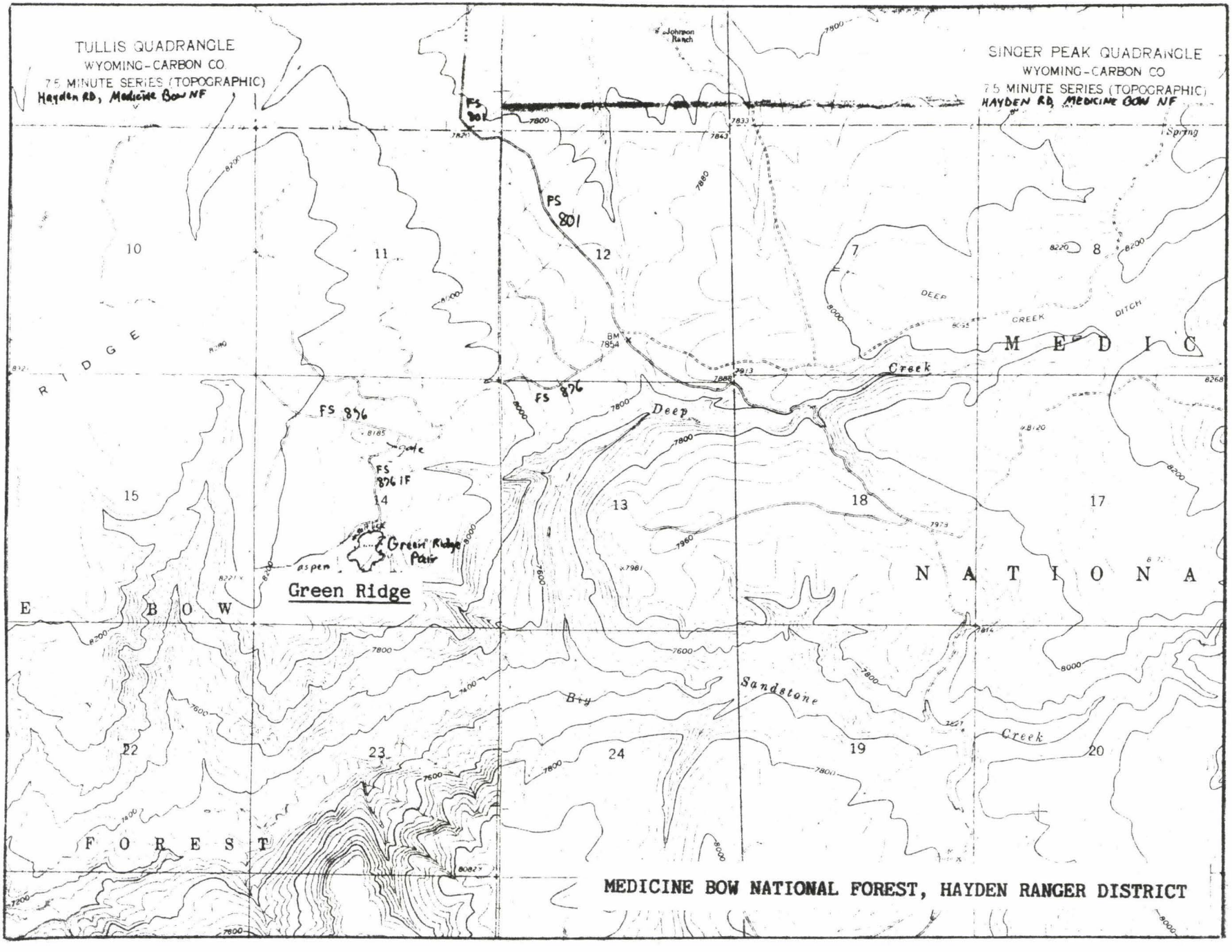
Poor portion of cut is half closest to salt lick and cow trail. Browsing and trampling are evident on this half where less slash was left, making access easier. Some 1 and 2 yr old sprouts were tallied, indicating that this portion of the stand might improve given a chance. The salt lick was in the same place 2 consectutive summers (7/88 and 6/89). Simply enforcing the movement of the salt lick might ease some of the herbivore pressure.

Predominant understory is slash, grasses, snowberry. In 10 plots surveyed 6/89, 28 dominant sprouts were measured: 1-9 yrs old, ave. diam. 2.4 cm, ave. ht. 1.5 m, ave. percent of crown alive 40%. Average number of live sprouts per plot 3.8, and dead 6.3.

Good Portion of Cut

In the good half of the cut, piles of slash have effectively limited herbivore use. Predominant understory is slash, Ligusticum, grasses; a few large lodgepole pine present.

In 10 plots surveyed 6/89, 27 dominant sprouts were measured: 5-10 yrs old, ave. diam. 4.8 cm, ave. height 4.4 m, ave. percent crown alive 80%. Average number of live sprouts per plot 4.3, and dead 2.2.


TULLIS QUADRANGLE
WYOMING-CARBON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
Hayden RD, Medicine Bow NF
SINGER PEAK QUADRANGLE
WYOMING-CARBON CO
7.5 MINUTE SERIES (TOPOGRAPHIC)
HAYDEN RD, MEDICINE BOW NF
FS 801
FS 876
FS 876.1F
Green Ridge
Green Ridge Pass
Deep Creek
Sandstone Creek
DEEP CREEK DITCH
RIDGE
MEDIC
NATIONA
E B O W
FOREST
MEDICINE BOW NATIONAL FOREST, HAYDEN RANGER DISTRICT

PIKE AND SAN ISABEL NATIONAL FOREST, SOUTH PARK RANGER DISTRICT

Jefferson (Map on page 26)

T.7 S., R.75 W., S.19; elevation 10,400 ft; about 5 ac of aspen and lodgepole pine cut in 1983?; topographic position--ridge/upper slope. Aspen community type: POTR2/THD1, predominant understory: Thermopsis, grasses, yarrow.

From Forest Road 400, northwest of Jefferson, Colorado, turn right (north) onto Forest Road 401. Keep heading north past junctions to Jefferson Boundary Picnic Ground and Overflow Camping. After almost one mile past junctions, there is a gate. Head north/northeast for 0.3 miles to Forest Road 427. After 0.1 mile on FS 427, cut stand is east or road.

Poor Portion of Cut

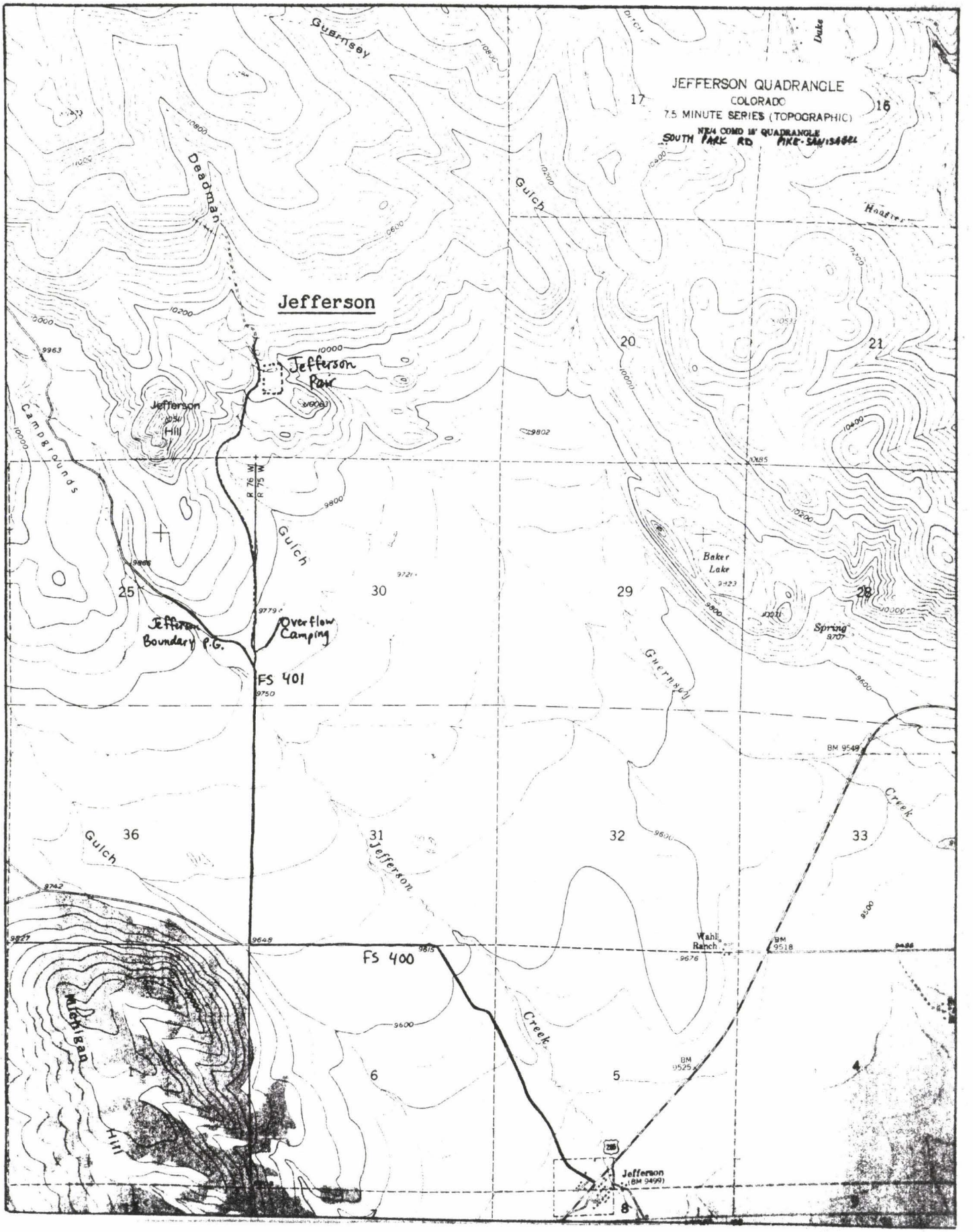
Poor portion is northern third of cut, sloping 4% to E, separated from good portion by a bare gap with some conifer regeneration. Cytospora was noted and shepherd's crook was common.

In 10 plots surveyed 8/88, 18 dominant sprouts were measured: 2-9 yrs old, ave. diam. 2 cm, ave. height 1.1 m, ave percent crown alive 54%. Average number of live sprouts per plot 3.2, and dead 1.1.

Good Portion of Cut

Good portion is southern 2/3 of cut below gap with conifer regeneration, sloping 3% to SE. Shepherd's crook was common, but no Cytospora noted. It is possible that the poor and good portions are 2 different clones.

In 10 plots surveyed in 8/88, 29 dominant sprouts were measured: 3-6 yrs old, ave. diam. 2.3 cm, ave. height 1.6 m, ave. percent crown alive 93%. Average number of live sprouts per plot 16.2, and dead 2.2.



PIKE AND SAN ISABEL NATIONAL FOREST, SOUTH PARK RANGER DISTRICT

ROUTT NATIONAL FOREST, YAMPA RANGER DISTRICT

Black Horse (Map on page 29)

Poor Stand

T.1 N., R.82 W., S.20; stand 5503-03; elevation 9200 ft, 15 ac cut at age 70 in November 1984, sloping 5 to 30% to east. Habitat type: Abla-Pien/Vasc; predominant understory: grasses, vetch, strawberry.

On Colo HWY 134 west of Gore Pass, go 2.2 mi west of Gore Pass Campground, turn south on FS 206.1. After 1.1 mi turn left (south) at Y into forest; after 1.7 mi. turn left; after 0.2 mi turn right; after 0.2 mi turn left, after 0.4 mi the road leads into a clearcut.

The configuration of this cut is concave, with 30% slope on the west and 5% slope in the middle, dipping east toward Modlin Creek. Along the center of the cut toward the east, conditions are marshy with willows and moss. The willows continue on to the creek. First year sprouting was reported good, but sprouts were all but gone at the third year survey. The cut is bordered by mostly aspen and lodgepole pine, with browsing evident.

In 20 plots surveyed 6/88, 19 dominant aspen sprouts were measured: 1-2 yrs old, ave. diam. 0.6 cm, ave. height 0.5 m, and ave. percent of crown alive %. Average number of live sprouts per plot 3.4, and dead 0.5. Sprouts were found mostly toward the edges of the cut.

Apparently the combination of wet site drowning root systems in the center of the cut, plus herbivore pressure from the newly opened "highway" to the creek (deer near the edges, cattle more in the open) caused the failure of aspen regeneration. Lodgepole pine regeneration is scattered in the opening, so the site will eventually return to trees.

Good Stand

T.1 N., R.82 W., S.18; stand 254926-27; elevation 9000 ft; 4 ac cut in 1985, sloping 12% to NE; midslope topographic position. Habitat type: Abla-Pien/Cage; predominant understory: geranium, grasses, vetch.

On Colo 134, 2.2 mi west of Gore Pass summit, turn south on FS 206 (called the Old Highway; heads west), after 1.1 mi head right at fork, after 1 mi turn left (south). Keep right for 0.6 mi then turn left. Stand is 250 m past the FS gate, on both sides of the road.

This stand is surrounded by mostly lodgepole pine and subalpine fir, and the road is closed by a gate. At the time of the survey 6/88, the stand was doing well, but many stem died over the winter of 1988-89. Snow damage and browsing were evident mostly in the middle of the cut. This area is open for grazing.

In 11 plots, 33 dominant aspen sprouts were measured: 2-5 yrs old, ave. diam. 1.4 cm, ave. height 0.9 m; ave. percent of crown alive 56%. There were many standing dead sprouts. The average number of live sprouts per plot was 6.3, and dead 6.0.

ROUTT NATIONAL FOREST, YAMPA RANGER DISTRICT

Porcupine Pair (Map on page 29)

Poor Stand

T.1 N., R.83 W., S.03; Stand 254912-26. Elevation 9080 ft; 6 ac cut summers 1983-84, sloping 5-25% to the south; midslope topographic position. Habitat type: Abla-Pien/Cage, but ecotonal to sage meadow. Predominant understory: grasses, geranium, sage brush, yarrow.

On Colo 134 east from Toponas, Colo, turn left (east) onto FS 275. Stand is 1 mi east on FS 275, north of road. From the other direction, west on Colo 134 from Gore Pass, turn right (NW) on FS 270. After 0.4 mi turn left (west) on FS 275. Stand is at 0.8 mi., north of road.

This is a dry site between lodgepole pine and sage meadow. A small clump of willows with sage brush and shrub cinquefoil indicate some sub-irrigation in the middle of the cut where very few ratty aspen seedlings survive. More aspen sprouts were growing where lodgepole pine provides partial shade. Exposure after cutting increased moisture stress and respiration for the sprouts and the root system. Herbivore use probably helped eliminate sprouts on this southern slope where the snow melts early. The sprouts in the shade of the lodgepole are under the snow longer.

In 10 plots surveyed 6/88, 8 dominant sprouts were measured: 1-3 yrs. old, ave. diam. 1 cm, ave. height 0.5 m, ave. percent of crown alive 55%. Average number of live sprouts per plot 1.3, and dead 0.6.

Good Stand

T.1 N., R.82 W., S.10; stand 255001-28. Elevation 9460 ft; 5 ac cut 8/86, sloping 15% to southwest; midslope topographic position. Habitat type: Abla-Pien/Vasc. ph. Cage or Arco2. Predominant understory: brome, Carex, slash.

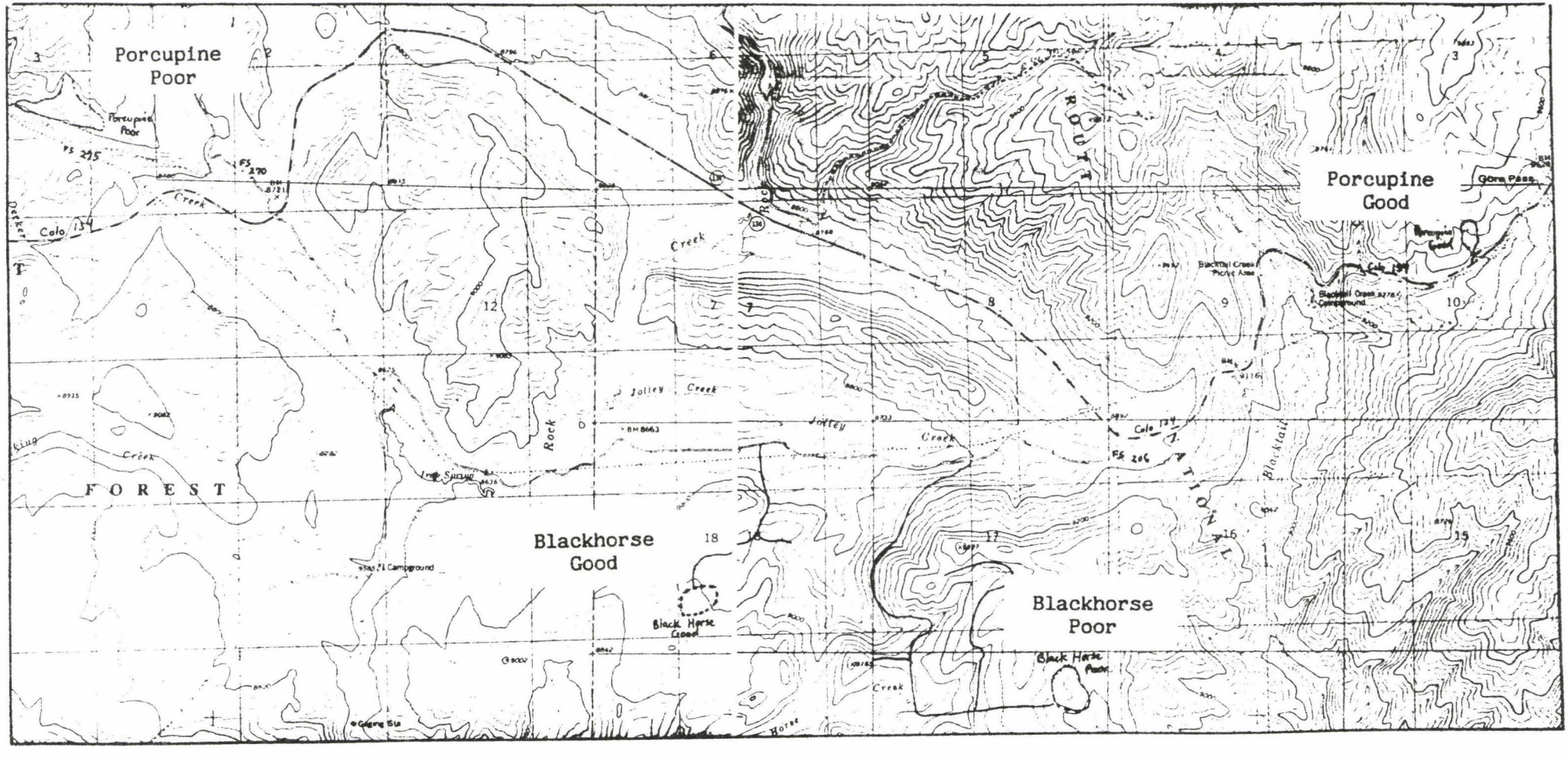
West on Colo 134 from Gore Pass, 0.5 mi west of Gore Pass Camp Ground to old landing on right side of road. Stand is north of road, past a berm blocking the old logging road to the north.

Regeneration is good in this cut in the middle of a tall lodgepole pine forest. Browsing, bedding down spots, and deer and elk droppings evident.

In 12 plots surveyed 6/89, 36 dominant sprouts were measured: 2-4 yrs old, ave. diam. 0.9 cm, ave. height 0.9 m, ave. percent of crown alive 97%. Average number of live sprouts per plot 21.8, and dead 0.5.

LYNX PASS QUADRANGLE
COLORADO
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 GORE PASS 15' QUADRANGLE
Yampa R.D Routt NF

GORE PASS QUADRANGLE
COLORADO—GRAND CO
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 GORE PASS 15' QUADRANGLE
Yampa R.D Routt NF



Routt National Forest
Yampa Ranger District

ROUTT NATIONAL FOREST, YAMPA RANGER DISTRICT

Chapman Pair (Map on page 31)

Poor Stand

T.3 N., R.86 W., S.30; stand 255702-39. Elevation 8880 ft, 5 ac cut summers 1983-84, sloping 5% to east along a stream bottom. Age at cutting 70-80 yrs. Habitat type: Abla-Pien/Cage, but ecotonal to riparian with rising water table. Predominant understory: corn husk lily, Ligusticum, tall delphinium.

On county road 017 northwest of Yampa, Colo., to county road 132, to FS 16 toward Dunckley Pass. Go 3.1 mi west of forest boundary, to junction of FS 940 (to Chapman Reservoir). Cut is west of road in stream bottom.

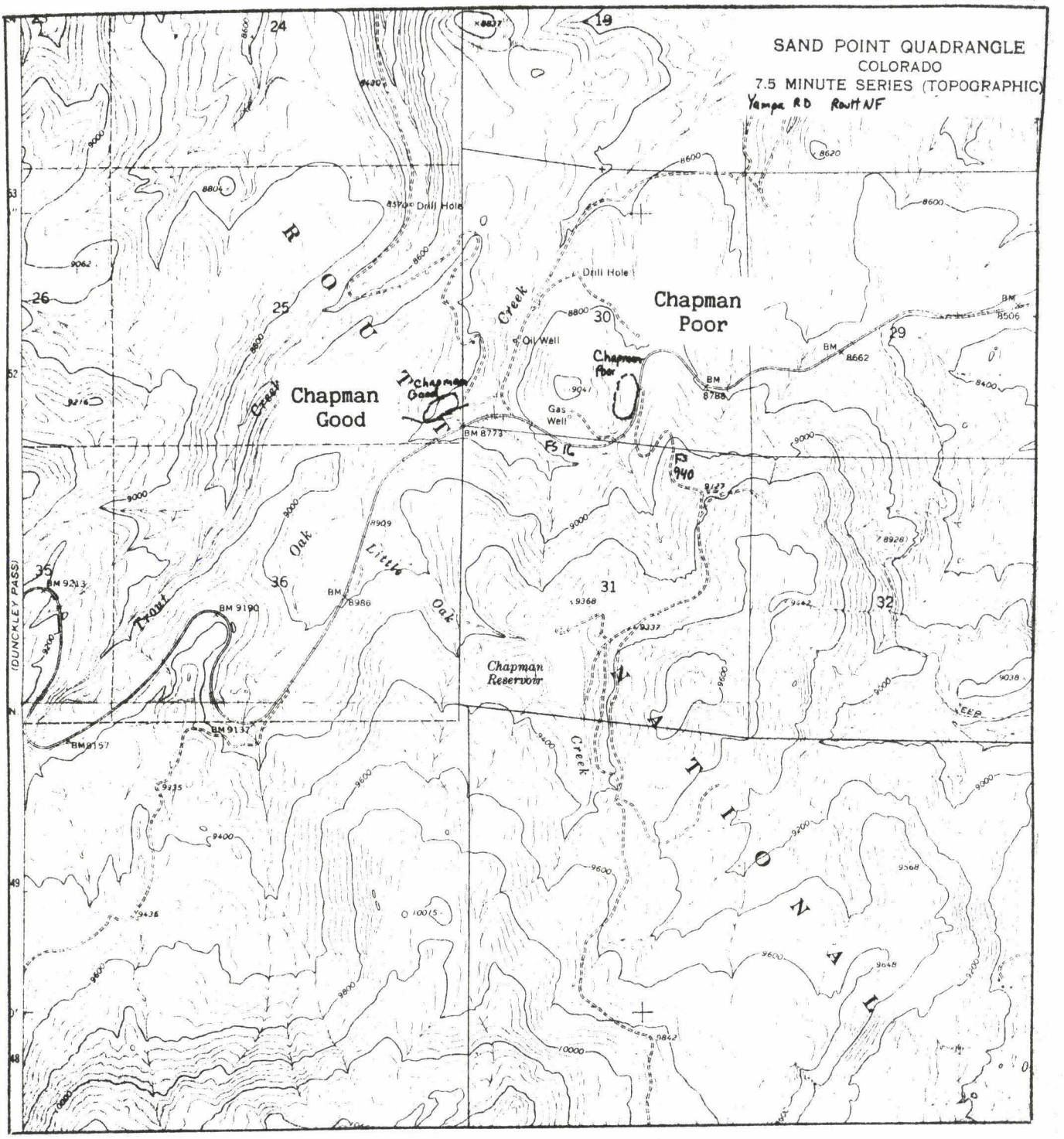
When surveyed 6/88, this cut was a dense stand of corn husk lily. Subalpine fir were scattered in the vicinity. In 10 plots no aspen sprouts were found. This is apparently a classic case of cutting on a wet site where the mature trees had been transpiring large quantities of water, keeping the site mesic enough for trees. Once the transpiration pumps were removed, the water table rose and drowned the aspen root system. If drought times continue long enough, trees may be able to eventually reoccupy the site. A few sprouts were observed near the edges of the cut and subalpine fir may be able to seed in at a slow rate.

Good Stand

T.3 N., R.87 W., S.25; stand 255602-38; elevation 8800 ft. 5? ac cut 1977?, sloping 27% to southeast, midslope topographic position. Habitat type: Abla-Pien/Cage. Predominant understory: snowberry, osmorhiza, grasses.

On FS 16 northwest of Yampa, Colo, west toward Dunckley Pass. From junction of FS 16 and FS 940 (to Chapman Reservoir), head west on FS 16 past road on right which goes to gas well at 0.2 mi. Turn right (north) on road to oil well at 0.6 mi, turn left (west) at 0.1 mi., turn left again onto logging road at 0.1 mi. Head west for 0.3 mi. Cut stand is on both sides of the road.

In 10 plots surveyed 6/88, 20 dominant sprouts were measured: 5-10 yrs old, ave. diam. 4.8 cm, ave. height 4.6 m, ave. percent of crown alive 93%. Average number of live sprouts per plot 3.5, and dead 0.2. Occasional snow creep and frequent mechanical wounding noted. This stand is surrounded by mixed aspen, lodgepole pine, subalpine fir, and Engelman spruce forest. Not much herbivore use evident, perhaps partly because of slope.



Routt National Forest
Yampa Ranger District

COLORADO STATE LAND, NEAR ROUTT NATIONAL FOREST, MIDDLE PARK RANGER DISTRICT

Carter Mountain (Map on page 33)

T.4 N., R.81 W., S.24 and part 23; stand 83-1, "Outhouse Unit". 63 ac cut winter 1983. Subalpine fire habitat type.

On US 40 north of Kremmling, Colo, turn right (northeast) on FS 103 (Chimney Rock Road). At 5.1 mi there is a clearing on the right with an outhouse. Cut stand is west of road on the hillside.

Poor Portion of Stand

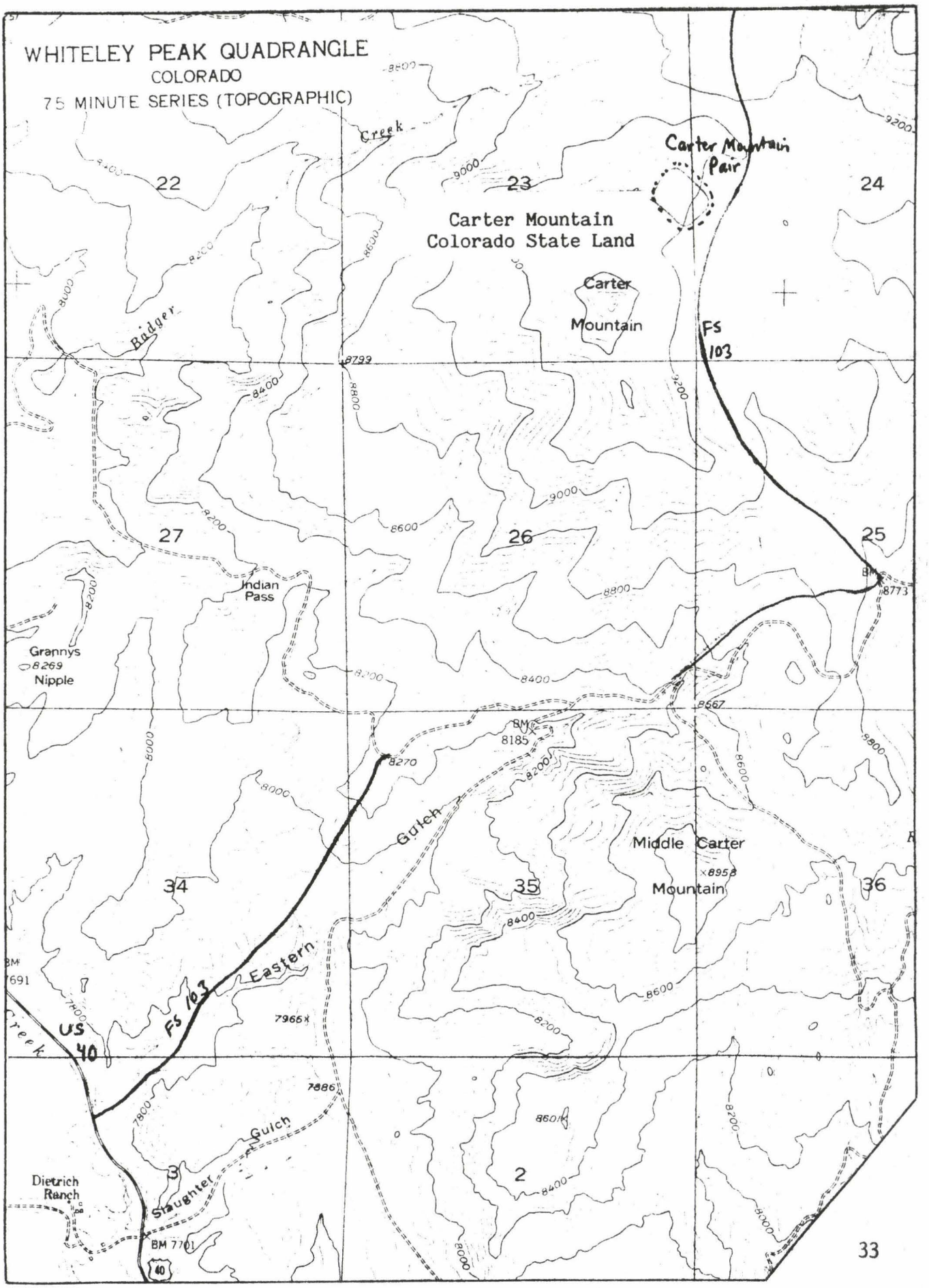
The portion with poor regeneration is the lower 13 ac, sloping 12% to southeast, elevation 9200 ft. Predominant understory: grasses, strawberry, vetch. At the bottom of the hill, there is a spring with a salt lick and corn husk lilies where cattle congregate. Above and north of the spring are a bulldozed landing and skid road. Regeneration is poor from a little above the spring, landing, and road down to the bottom of the slope. Browsing is heavy on the lower slope, but the soil also changes. In the area of poor regeneration, 14" of dark loam covers a reddish brown clay layer.

In 11 plots surveyed 6/88, 26 dominant sprouts were measured: 1-3 yrs old, ave. diam. 1.4 cm, ave. height 0.9 m, ave. percent crown alive 33%. Average number of live sprouts per plot 4.1, and dead 5.5.

Good Portion of Stand

The portion with good regeneration is 50 ac on the mid and upper slopes, sloping 25% to southeast, elevation 9240 ft. Predominant understory: grasses, vetch, geranium. The good regeneration grades rather quickly into poor regeneration on the lower slope where the slope decreases in the vicinity of the cattle and compacted area. Further north away from this area, aspen regeneration is still pretty good even after the slope decreases. On the upper slope, soil consisted of over 1 m of dark loam with some white clay. On the mid slope where the regeneration is still good, soil consisted of 0.7 m of dark loam over white clay.

in 12 plots surveyed 6/88, 34 dominant sprouts were measured: 1-4 yrs old, ave. diam. 1.8 cm, ave. height 1.3 m, ave. percent crown alive 86%. Average number of live sprouts per plot 11.3, and dead 2.8.


WHITELEY PEAK QUADRANGLE
COLORADO
75 MINUTE SERIES (TOPOGRAPHIC)
Carter Mountain Pair
Carter Mountain
Colorado State Land
Carter
Mountain
FS 103
Badger
Creek
Indian Pass
Grannys
8269
Nipple
Middle Carter
8958
Mountain
Gulch
Eastern
Creek
US 40
FS 103
Dietrich Ranch
Gulch
Slaughter
BM 7701
22
23
24
25
26
27
34
35
36
3
2
8799
8773
8567
8270
BM 8185
7691
7966X
7886
8601
8600
8400
8200
8000
7800
9000
9200
8800

SAN JUAN NATIONAL FOREST, DOLORES RANGER DISTRICT

Stoner Mesa, Stand 64 (Map on page 35)

T.40 N., R.13 W., S.36; stand 101905-20. Elevation 9320 ft, about 15 ac cut 7/76, sloping 18% to northwest. Spruce habitat type, scattered corn husk lily. Grazed area.

On Colo 145 east of Dolores, Colo., turn north on FS 535, turn east on FS 686. Go about 5 mi on FS 686 to FS 875. Turn southeast on FS 875, go 0.5 mi to junction of FS 335. Continue on FS 875 0.2 mi to junction of FS 345; continue on FS 875 1.1 mi. Stand is above road to the south, through border of tall aspen.

This stand was observed by Wayne Shepperd to have 70% mortality/damage in 1984 or 1985. There has been snow damage in the past.

Poor Portion of Stand

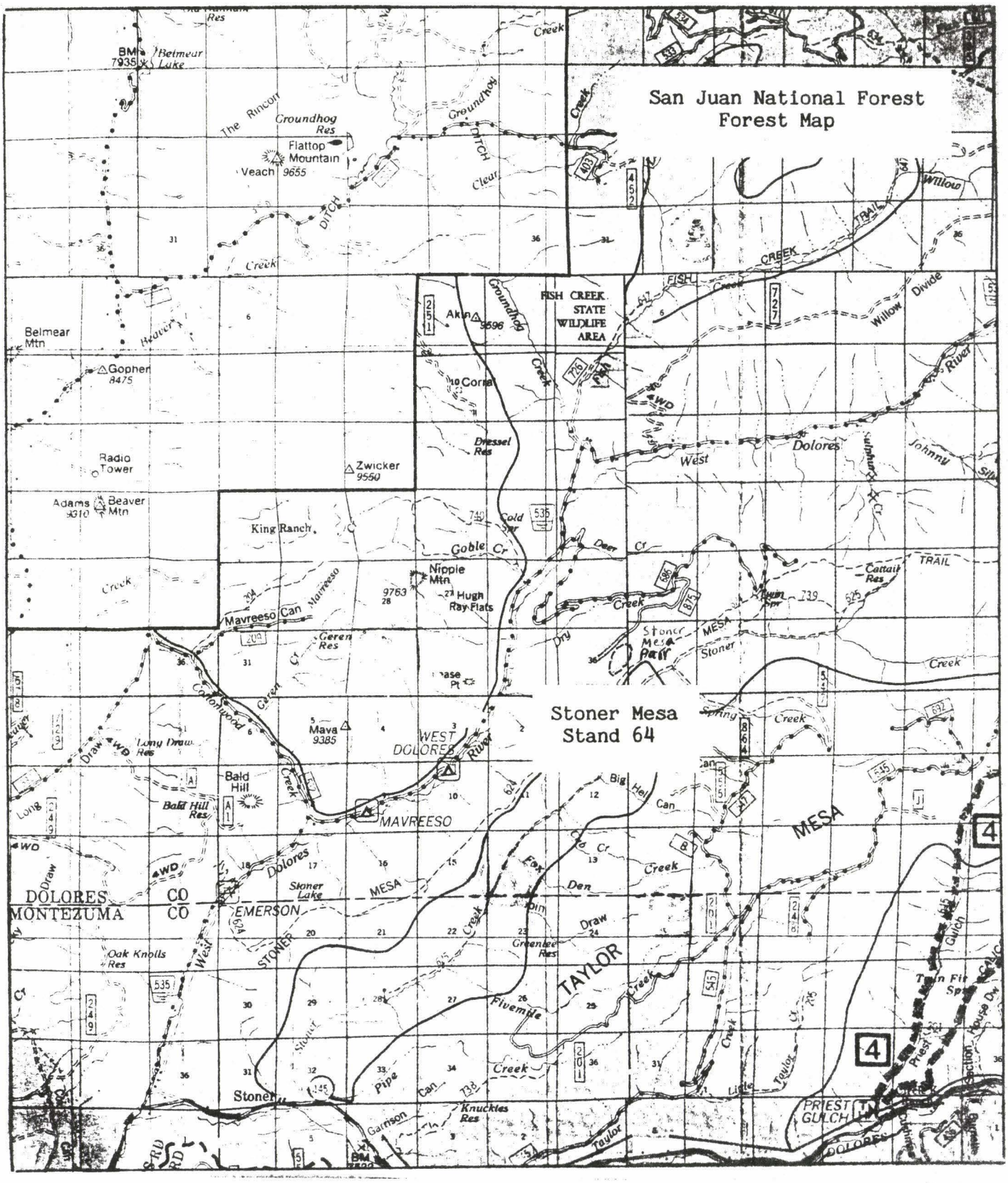
The middle portion of the stand has poor sprout survival. The predominant understory is Ligusticum, grasses, and snowberry.

In 12 plots surveyed 7/88, 18 dominant sprouts were measured (only 6 were alive): 3-8 yrs old, ave. height 2.4 m, ave. diam. 3.0 cm, ave. percent of crown alive 30%. Average number of live sprouts per plot 0.5, and dead 1.3.

Good Portion of Stand

Good sprout survival is mostly along edges of the stand. Predominant understory is Ligusticum, snowberry, and osmorhiza.

In 10 plots surveyed 7/88, 20 dominant sprouts were measured: 5-10 yrs. old, ave. height 4.3 m, ave. diam. 4.8 cm, ave. percent of crown alive 77%. Average number of live sprouts per plot 1.9, and dead 1.3. Growth ring widths showed poor growth about 1983 or 1984.



SAN JUAN NATIONAL FOREST, DOLORES RANGER DISTRICT

SAN JUAN NATIONAL FOREST, MANCOS RANGER DISTRICT

Aspen Guard Station (Map on page 38)

Poor Stand

T.37 N., R.12 W., S.10; stand 103303-35. Elevation 9800 ft, about 4 ac cut 1985, sloping 10% to west. Predominant understory: grasses, Ligusticum, and geranium.

Northeast of Mancos, Colo, head northeast on FS 561 past Aspen Guard Station to junction of FS 350 (Spruce Mill Road). Turn southeast onto FS 350, go 1.7 mi to cattle guard. Cut stand is northeast of cattle guard.

In 12 plots surveyed 7/88, only 3 aspen sprouts were tallied, all alive: two 3 yr olds and one 6 yr old, ave. height 1.3 m, ave. diam. 1.5 cm, ave. percent of crown alive 98%. Some slash was left but access is easy. Aspen sprouts were scattered in this well grazed area with compaction apparent toward cattle guard. On May 23, 1990, a new drop-down fence had been constructed across the cut, and the area was well-trampled by herbivores. In this area, the cattle are accustomed to lingering in the openings.

Good Stand

T.37 N., R.12 W., S.9; stand 103302-36, 37. Elevation 9440 ft, about 35 ac cut 1985?, sloping 8% to northwest. Predominant understory: snowberry, geranium, Ligusticum.

Northeast of Mancos, Colo, head northeast on FS 561 past Aspen Guard Station to junction of FS 350 (Spruce Mill Road). Turn southeast on FS 350, go 0.2 mi. Cut stand is south of road.

In 10 plots surveyed 7/88, 27 dominant sprouts were measured: 2-3 yrs old, ave. height 2 m, ave. diam. 2.4 cm, ave. percent of crown alive 97%. Average number of live sprouts per plot 15.7, and dead zero. Large slash made walking difficult. Some evidence of cattle use (dung and trails), some shepherd's crook.

Dr. Dave Jamison (Fort Lewis College, Durango) found the same understory plants in both stands, but not necessarily in the same proportions.

SAN JUAN NATIONAL FOREST, MANCOS RANGER DISTRICT

Burnt Ridge (Map on page 38)

T.37 N., R.12 W., S.34; stand 103110-24. Elevation 10,060 ft, about 7 ac cut in 1983 or 1984?

On FS 566, northeast of Mancos, Colo., turn southeast on loop (still FS 566). From beginning of loop, go 1.4 mi. Stand is southwest of road, with many old downed logs.

Poor Portion of Stand

Portion of stand regenerating poorly is about 2 ac to southeast, sloping 13% to west. Predominant understory is Ligusticum, Mertensia, and corn husk lily.

In 10 plots surveyed 7/88, 12 dominant sprouts were measured: 2-4 yrs. old, ave. ht. 0.9 m, ave. diam. 1.4 cm, ave. percent of crown alive 82%. Average number of live sprouts per plot 1.3, and dead 0.2. Drainage seems poor here. Most of sprouts showed browsing and mechanical wounding. Some had shepherd's crook.

Good Portion of Stand

This portion is about 5 ac to northwest, sloping 18% to west, with better drainage. Predominant understory is corn husk lily, Ligusticum, and Mertensia.

In 10 plots surveyed 7/88, 30 dominant sprouts were measured: 1-4 yrs old, ave. height 1.4 m, ave. diam. 1.9 cm, ave. percent of crown alive 91%. Average number of live sprouts per plot 9.5, and dead 1.7. Some mechanical wounding and lots of shepherd's crook noted.

SAN JUAN NATIONAL FOREST, MANCOS RANGER DISTRICT